REMARKS

This is in response to the Office Action dated September 8, 2004. This amendment should be entered since the only claim changes herein are for purposes of clarification. The instant specification clearly supports use of the word scattering (e.g., pg. 4, line 6). Claims 1-8 and 15-26 are pending.

Applicant notes with appreciation the Examiner's indication that claims 23-24 contain allowable subject matter.

Claim 1 - - Section 103(a) Art Rejection

Claim 1 stands rejected under 35 U.S.C. Section 103(a) as being allegedly unpatentable over Krames in view of Saeki and Vakhshoori. This 3-way Section 103(a) rejection is respectfully traversed for at least the following reasons.

Claim 1 requires "a DBR (Distributed Bragg Reflector) and a light-emitting layer supported by at least a substrate comprising GaAs, the DBR being located between the substrate comprising GaAs and the light-emitting layer, wherein light directed from the light-emitting layer toward a top surface of the light-emitting device has a radiation angle dependence; a semiconductor layer formed over at least the light-emitting layer, a top surface of the semiconductor layer comprising a roughened surface which is not at least partially covered by the other semiconductor layers in order to cause light output from the light-emitting device to be scattered upon leaving the top surface of the device; and wherein no DBR is provided between the light-emitting layer and the semiconductor layer having the top surface that is roughened."

Vakhshoori is entirely unrelated to the invention of claim 1. In particular, claim 1 requires that the top surface of the semiconductor layer is at least partially roughened in a manner which causes "light output from the light-emitting device to be scattered upon leaving

the top surface of the device." To be "scattered" means that the light has no preferred direction and has substantially random directionality. Vakhshoori teaches the opposite of claim 1 in this respect. Instead of causing output light to be scattered as called for in claim 1, Vakhshoori uses a type of roughness for the express purpose of causing output light to be focused (see Fig. 2; col. 1, lines 50-55; and col. 3, line 55). Thus, it can be seen that Vakhshoori teaches directly away from the invention of claim 1 and is unrelated to the same.

Furthermore, the Examiner's allegation regarding a mirror function teaching of Vakshoori in the Office Action is incorrect. In particular, the Office Action states that Vakshoori teaches that a mirror function can be obtained by a single layer (citing column 3, line 4), so that substitution of a DBR of Krames by a single layer would have been obvious. The Examiner's interpretation of Vakshoori is wrong in this respect. In contrast to the incorrect statements in the Office Action, the mirror function cannot be obtained by a single layer as alleged by the Examiner because a p-type AlGaAs upper mirror (12) is also disclosed at col. 3, line 8, as clearly shown in Fig. 1. In other words, to achieve a mirror, Vakshoori requires both a lower mirror layer of n+ AlGaAs (col. 3,line 4) and an upper mirror layer of p-type AlGaAs (col. 3, line 8). A single layer cannot achieve mirror functionality in Vakshoori. Thus, in direct contrast to the Examiner's unsupported allegation, the mirror function in Vakshoori is achieved by a pair of mirrors – not a single mirror. This means that the device of Vakshoori is an RCLED which is the opposite of what the invention of claim 1 requires. The very basis of the Section 103(a) rejection is based on a misunderstanding of the cited art, thereby evidencing that the Section 103(a) rejection is incorrect and should be withdrawn.

The Office Action also relies on Fig. 13 of Krames. However, in direct contrast to claim 1, the device shown in Fig. 13 of Krames is an RC (Resonance Cavity)-LED necessarily having

by definition both an upper DBR (20B) and a lower DBR (20A) (col. 9, lines 5-15). Contrary to what is alleged in the Office Action, one of ordinary skill in the art would never even consider removing the upper DBR from Fig. 13 of Krames as alleged in the Office Action, because this upper DBR is an absolute requirement of the device and its removal would destroy the functionality of the device. In other words, one of ordinary skill in the art would never have removed the upper DBR from Fig. 13 of Krames as alleged in the Office Action, because this would destroy the functionality and operation of Krames' RCLED.

The Office Action also contends that it would have been obvious to have "texture[d] the top surface of the device of Saeki Fig. 8B as taught by Krames et al. with respect to figure 13." This contention is respectfully traversed. The device of Saeki is designed to reduce the operation voltage and increase optical output. To achieve this, a contact layer (22) doped with carbon for reducing the contact resistance with ITO electrode (16) is provided and an intermediate band gap layer (21) is interposed between the contact layer (22) and the cladding layer (15) for alleviating band discontinuity, thereby promoting inflow of holes and decreasing resistance. Consequently, these the need is met by the use of such layers and there would have been no need to further enhance light emission by texturing the top surface of the device.

Moreover, the ordered textures of Krames Fig. 13 are designed to efficiently couple emitted light into ambient (col. 9, lines 5-10), which is much different than the scattering function required by claim 1. The Examiner relies on Fig. 13 of Krames for alleged diffusion. In particular, the Examiner has contended that diffusion, or spreading out, of the emission profile is shown in Figure 13 of Krames et al., for example, where the lobes of the profile indicate the spread. *The Examiner has misinterpreted Krames in this regard*; Krames discloses no scattering. In particular, the lobes in Krames indicate only the spreading spectrum of the emitted light from

the active region (2) and they are not scattered because they have not yet reached the surface. Again, the basis of the Section 103(a) rejection is incorrect, thereby evidencing that the Section 103(a) rejection in incorrect and should be withdrawn.

On page 3 of the Office Action, the Examiner states that "applicant argues that the Vakshoori reference does not teach that a single layer can function as a mirror." In this respect, applicant does not argue that the lower mirror (11) of Vakshoori does not function as a mirror. The point is that it does not function as a resonator itself and does not perform emitting light as a whole in this respect if the upper mirror (12) is removed.

Also on page 3 of the Office Action, the Examiner states that "the differences in function would be precisely what would motivate a designer to choose one configuration or the other . . . the function of emitting light is not 'destroyed' in either case." In response, it is pointed out that one may choose between a RCLED, and an LED with only a lower DBR. However, once an RCLED is chosen (Krames chose an RCLED), one would never remove the upper DBR because then it would not properly emit light and its function would be destroyed.

For at least the aforesaid reasons, it is respectfully requested that the rejection of claim 1 be withdrawn.

Claim 15

Claim 15 states that "a roughened surface which is not at least partially covered by the other semiconductor layers in order to cause light output from the light-emitting device to be scattered upon leaving the top surface of the device; and wherein no DBR is provided between the light-emitting layer and the semiconductor layer having the top surface that is roughened." The cited art fails to disclose or suggest these aspects of amended claim 15.

Claims 25-26

Claims 25-26 require that "no mirror/reflector is provided between the light-emitting layer and the semiconductor layer having the top surface that is roughened." The cited art fails to disclose or suggest this.

The Office Action contends that it would have been obvious to have replaced the upper DBR of Krames with the mirror/reflector of Vakhshoori (this alleged modification has been traversed above). However, even if this modification were made, the inventions of claims 25-26 still would not be met. There would still be a reflector between the light emitting layer and the roughened surface, which is expressly excluded by these claims. Thus, even the alleged combination set forth in the Office Action fails to meet the inventions of claims 25-26.

On page 2 of the Office Action, it is argued by the Examiner with respect to claims 25-26 that Saeki "motivates leaving out the top DBR of the Krames device, if the function of this structure is not desired." This allegation is respectfully traversed. Krame's device is an RC (Resonant Cavity) LED having the active layer (2) interposed between the upper and lower DBRs (20A, 20B) as shown in Fig. 13. Both DBRs in Krames are required, and they are both indispensable for the emitted light to be resonated as an available output light. Thus, the function of both DBRs is required, and to remove one of them as alleged in the Office Action is unthinkable and would destroy the function of the base device.

Claims 8, 21-22

Claims 21-22 require that "the semiconductor with roughened surface has a lattice constant different by 0.5% or more than that of the substrate comprising GaAs." The cited art fails to disclose or suggest this aspect of these claims.

The instant specification explains that this lattice constant difference of 0.5% or more is highly advantageous in that it allows the wafer surface to be roughened by a sequence of crystal growth due to the lattice constant difference, thereby permitting a step of separately roughening the surface after crystal growth to be eliminated (e.g., pg. 8, lines 3-10; pg. 11, lines 5-18). The cited art fails to disclose or suggest the aforesaid quoted aspect of claims 21-22. Claim 8 defines over the cited art in a similar manner.

On page 2 of the Office Action, it is argued by the Examiner with respect to claims 21-22 that "differences in lattice constants as recited would have been obvious in order to allow for different types of semiconductor layers within the device that give rise to different desired wavelength outputs." This contention is respectfully traversed. The instant specification establishes unexpected results and criticality as to this range, and explains that this lattice constant difference of 0.5% or more is highly advantageous in that it allows the wafer surface to be roughened by a sequence of crystal growth due to the lattice constant difference thereby permitting a step of separately roughening the surface after crystal growth to be eliminated (e.g., pg. 8, lines 3-10; pg. 11, lines 5-18). There is absolutely nothing in the cited art which discloses or suggests this claimed range. Moreover, this difference in lattice constant may be used in certain example non-limiting embodiments in order to obtain a roughened surface via a sequence of crystal growth.

Conclusion

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

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